

ABSTRACT

A reliable and cost-efficient direct drive force feedback motor is suitable for joystick applications, allowing multiple degrees of output freedom, requiring no coil commutation, and permitting compact packaging. A multiple degree-of-freedom motor
5 consistent with the invention comprises an output shaft, a stator, and a rotor. The stator comprises first and second lamination stacks, each lamination stack having an interior curved surface and a coil wound thereon, the lamination stacks being disposed adjacent the output shaft. The rotor is fixed to the output shaft and movably supported adjacent the stator with an air gap disposed between the rotor and the stator, the rotor including at
10 least one magnet disposed thereon and being movable along the interior curved surface of the lamination stacks in directions defining at least first and second degrees of freedom. Energization of the coil of the first lamination stack establishes a first magnetic field to urge the output shaft to rotate in a first plane, and energization of the coil of the second lamination stack establishes a second magnetic field to urge the output shaft to rotate in a
15 second plane substantially orthogonal to the first plane.